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RESPONSES OF BREEDING AMERICAN KESTRELS TO LIVE AND MOUNTED GREAT HORNED OWLS

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Abstract.—Behavioral responses of American Kestrels (*Falco sparverius*) to a live and taxidermic mount of a Great Horned Owl (*Bubo virginianus*) were studied during 2 breeding seasons in southwestern Quebec. Kestrels responded less aggressively to taxidermic mounts, particularly as distance of the owl from the nestbox increased. Intensity of aggression did not increase from incubation to nestling period. Aggressive response to live owls suggests that Great Horned Owls are recognized as potential predators of fledging kestrels.

Interspecific aggression by raptors during the breeding season is poorly documented. Most raptors defend territories against conspecifics, but raptors occasionally exhibit aggressive behavior toward ecologically similar species as a result of competition for food and breeding territories (Mikkola 1976; Bluhm and Ward 1979). Predation on other raptor species is uncommon, although Great Horned Owls (*Bubo virginianus*) are known to kill raptors as large as Northern Goshawks (*Accipiter gentilis*) (Newton 1979). Kerlinger and Lehrer (1982) reported that migrating Sharp-shinned Hawks (*A. striatus*) recognized a Great Horned Owl model, aggressively attacking from distances > 30 m, suggesting that Sharp-shinned Hawks may frequently be preyed upon by Great Horned Owls and hence display aggressive behavior toward the owl in daylight hours.

During nest establishment, American Kestrels (*Falco sparverius*) direct aggressive behavior primarily against non-raptorial cavity nesters, perhaps due to competition for nest sites. Kestrel aggression toward other raptors increases throughout the breeding season and peaks as the young fledge (Balgooyen 1976).

Our study tests whether aggressive behavior by American Kestrels toward Great Horned Owls varies with respect to stage of the reproductive period and distance from the nest. As Knight and Temple (1986a) pointed out, many studies of avian nest defense assume, without testing, that parents behave similarly to taxidermic mounts of potential predators as to a living bird. We examined whether kestrels react similarly to a live bird and a mounted specimen.

Study Area and Methods

Our study was conducted on the western end of the island of Montreal, Ile Perrot and eastern sections of Vaudreuil-Soulanges County in southwestern Quebec. Tests were performed on kestrels breeding in nestboxes erected by the Macdonald Raptor Research Centre, primarily in northern hardwoods in hedgerows bordering fallow agricultural fields. Data were collected on 9 nests from mid-incubation to mid-nestling stage from 16 May–14 July 1982. Six nests were tested during the mid-nestling stage from 20 June–6 July 1985.

We presented a live and a taxidermic mount of a Great Horned Owl to all nests to examine parental behavior Each live owl was tethered to a perch with leather jesses but was allowed unrestricted body movement. Each mounted owl was placed on a post in an upright position with ear tufts raised and wings folded against the body. Each mounted owl was positioned so as to face directly toward a nestbox. To increase conspicuousness to the kestrels, both versions of the owl were raised above the level of the surrounding vegetation. In 1982 each version was tested at 10, 50, and 100 m distance from the nest. Each stimulus was tested from farthest to nearest distance in consecutive tests within a single day. Sequence of presentation of live and mounted versions was randomly chosen at all nests To avoid excessive disturbance at least 1 d elapsed between trials with a live and mounted owl. In 1985 both stimuli were tested at 10 and 100 m, as was a live, white, Leghorn Chicken (*Gallus domesticus*) used as a control. The chicken was dyed with brown shoe dye to mimic owl coloration. In 1985 6 tests/nest (3 stimuli at 2 distances) were performed randomly at 2 d intervals to lessen habituation by the kestrels. After placement of each bird, observers retreated to a position approximately 100 m from the nestbox before recording observations. Within each year all observations were performed by the same observers to eliminate potential bias caused by novel intruders.

Two categories of aggressive behavior, number of dives and "klee" vocalizations, were recorded over a 10-min period. Each "klee" in an uninterrupted series of calls was counted as a separate vocalization. Dives resembled the pendulum attack as described by Balgooyen (1976). Aggressive behavior by both parents was summed to obtain total number of dives and vocalizations per test.

Data were analyzed using the Wilcoxon Signed Ranks test (Daniel 1978), and $P < 0.05$ was used for determining statistical significance.

Table 1. Intensity of aggressive responses of breeding American Kestrels to live and mounted Great Horned Owls during mid-incubation and mid-nestling stages 1982 and mid-nestling stage 1985.

Stimulus and Distance		No. of Pairs Reacting	Calls/10 Mins* ($\bar{x} \pm 1$ S.D.)	Dives/10 Mins* ($\bar{x} \pm 1$ S.D.)
a) Mid-incubation 1982				
Owl	10 m	6/9	9.67 ± 10.31^{a}	5.56 ± 6.11^{a}
Owl	50 m	7/9	7.11 ± 9.67^{abc}	3.89 ± 8.39^{a}
Owl	100 m	4/9	4.33 ± 6.69^{bc}	3.78 ± 6.61^{ab}
Mount	10 m	5/9	14.56 ± 8.84^{ab}	4.56 ± 5.34^{ab}
Mount	50 m	2/9	3.44 ± 8.05^{c}	2.11 ± 5.97^{b}
Mount	100 m	2/9	6.67 ± 13.31^{abc}	5.22 ± 13.89^{ab}
b) Mid-nestling 1982				
Owl	10 m	8/9	17.11 ± 26.07^{a}	6.44 ± 9.10^{ab}
Owl	50 m	7/9	11.33 ± 21.00^{a}	5.00 ± 10.25^{ab}
Owl	100 m	6/9	13.11 ± 19.64^{a}	4.89 ± 10.67^{b}
Mount	10 m	5/9	11.55 ± 14.63^{a}	8.56 ± 13.35^{a}
Mount	50 m	1/9	0.11 ± 0.33^{b}	0^{c}
Mount	100 m	2/9	0.33 ± 0.70^{b}	0.22 ± 0.67^{c}
c) Mid-nestling 1985				
Owl	10 m	6/6	84.00 ± 52.46^{a}	28.33 ± 19.72^{a}
Owl	100 m	3/6	33.17 ± 57.09^{b}	11.83 ± 20.77^{a}
Mount	10 m	2/6	5.67 ± 11.20^{bc}	0^{b}
Mount	100 m	0/6	0^{c}	0^{b}
Chicken	10 m	0/6	0^{c}	0^{b}
Chicken	100 m	1/6	0.83 ± 2.04^{c}	0.17 ± 0.41^{b}

* Values within a column that share a common superscript are not significantly different ($P > 0.05$).

RESULTS

During mid-incubation in 1982, a mounted owl at 50 m provoked the lowest mean number of dives and klees (Table 1a). During mid-nestling stage, a mounted owl at 50 and 100 m elicited significantly fewer vocalizations and dives from parents than all other stimuli (Table 1b). There were no significant differences in responses elicited by a live owl at all 3 distances and the taxidermic mount at 10 m, except that significantly fewer dives were directed at the owl at 100 m when compared to the mount at 10 m.

There was no significant increase in the number of dives or vocalizations performed by parents from incubation to nestling stages for the live owl at all distances or the mounted owl at 10 m.

In tests performed during mid-nestling stage in 1985 a live owl elicited significantly more vocalizations and dives at both distances than the other 2 stimuli (Table 1c). Significantly more vocalizations were directed at the live owl at 10 m than at 100 m, but there was no statistical difference with respect to number of dives. All pairs of kestrels reacted to the presence of the live owl, but not the taxidermic owl mount or chicken. Only 2 pairs of birds reacted to the taxidermic mount at 10 m and 1 pair responded with a low level of aggression to the chicken at 100 m.

Both sexes participated in aggressive displays. In 8 of 12 trials in 1985 where kestrels behaved aggressively toward any of the 3 stimuli, both birds were involved. In the remaining 4 cases, only the female was observed displaying aggressive behavior Males forage away from the nest while females remain near the nest (Balgooyen 1976), which probably accounts for differences in participation in aggressive acts between sexes. In trials where both parents were present, both emitted calls and dove at the stimulus.

DISCUSSION

In 1982 although the mean number of dives or vocalizations generally increased in all cases from incubation to nestling stages, nest defense behavior of individual pairs was highly variable. This factor explains the lack of significant increases for dives or vocalizations performed by parents from incubation to nestling periods.

For altricial birds a model of optimal levels of parental defense predicts that the intensity of defense will increase with nestling age due to a decline in relative difference of expected future survival between parent and offspring (Andersson et al. 1980). Since the American Kestrel is a cavity nester, eggs and nestlings are not easily accessible to Great Horned Owls. Parents might be expected to exhibit a low level of nest defense throughout the egg and nestling stages to discourage Great Horned Owls from remaining in the vicinity of the nest. Intensity of aggression should not increase as long as nestlings remain in the nest and risk of predation is low. Furthermore, pendulum attacks such as those we observed often involve prolonged periods of vigorous flying, an energetically demanding activity (Gessaman 1980). Albeit rare, aggressive displays also carry the risk of injury or death by the owl. Parental aggression might be expected to increase significantly during the first few days post-fledging while young fly poorly and are more vulnerable to predation, although not tested in our study.

Knight and Temple (1986b) have suggested that observed increases in nest-defense intensity during the nesting cycle may be attributable to experimental methods. Repeated exposure of breeding birds to potential predators without resultant harm to young results in positive reinforcement and a loss of fear of the predator (Knight and Temple 1986b). In our study the mean number of dives and vocalizations generally increased from incubation to nestling stage in 1982, but none of the increases was statistically significant. Responses of individual pairs of kestrels were highly variable. Some pairs showed increased aggression in the nestling stage while others showed decreased aggression relative to the incubation stage. Our results do not suggest that positive reinforcement or loss of fear of the Great Horned Owl was occurring.

Our results from 1982 and 1985 indicate that parents do not react similarly to live and mounted owls and support those obtained by Knight and Temple (1986a) (i.e., taxidermic mounts may not be an accurate method of assessing aggressive behavior by parents). In 1985 1 pair of kestrels reacted with limited aggression toward the chicken. However, aggression occurred soon after the chicken was placed in the field and may have been directed toward the observers. Consequently, kestrels appear able to differentiate a chicken from an owl as not being a potential threat to their young.

Several factors may account for differences observed in reactions of parents to live and mounted owls. Lack of movement by a mounted owl, or some other subtle cue, may signal kestrels that little threat to their young was being posed. When a mounted owl is placed far from the nest, parents may limit aggressive behavior to minimize the possibility of drawing the potential predator closer to the nest. However, when placed close to a nestbox, recognition of the owl's shape and proximity to their young may be sufficient to provoke an aggressive response without additional cues associated with a live owl (e.g., movement). Alternatively, inhibition of aggressive behavior may have occurred since the mounted owl was positioned to face directly at the nest box. Knight and Temple (1986a) claimed a similar inhibition took place when a live American Crow (*Corvus brachyrhynchos*) stared directly at mobbing Red-winged Blackbirds (*Agelaius phoeniceus*).

Results of our study indicate that American Kestrels recognize Great Horned Owls as potential predators of fledgings, a behavior which is likely innate. Similar tests should be performed outside the breeding season to determine if non-breeding adults regard owls as potential predators and react aggressively.

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LITERATURE CITED

ANDERSSON, M., C. G. WIKLUND AND H. RUNDGREN. 1980. Parental defence of offspring: a model and an example. *Ani. Behav.* 28:536–542.

BALGOOYEN, T. G. 1976. Behavior and ecology of the American Kestrel (*Falco sparverius* L.) in the Sierra Nevada of California. *Univ. Calif. Publ. Zool.* 103:1–87.

BLUHM, C. K. AND E. K. WARD. 1979. Great-horned Owl predation on a Short-eared Owl. *Condor* 81:307–308.

DANIEL, W. W. 1978. Applied nonparametric statistics Houghton Mifflin Co., Boston.

GESSAMAN, J. A. 1980. An evaluation of heart rate as an indirect measure of daily energy metabolism of the American Kestrel. *Comp. Biochem. Physiol.* 65A:273–289.

KERLINGER, P. AND P. H. LEHRER. 1982. Anti-predator responses of Sharp-shinned Hawks. *Raptor Res.* 16: 33–36.

KNIGHT, R. L. AND S. A. TEMPLE. 1986a. Methodological problems in studies of avian nest defence. *Ani. Behav.* 34:561–566.

——— AND ———. 1986b. Why does intensity of avian nest defense increase during the nesting cycle? *Auk* 103: 318–327.

MIKKOLA, H. 1976. Owls killing and killed by other owls and raptors in Europe. *Brit. Birds* 69:144–154.

NEWTON, I. 1979. Population ecology of raptors. Buteo Books, Vermillion, South Dakota.

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